Claims

What is claimed is:

1. A method of testing a semiconductor packaging material containing a molding compound for stability of the semiconductor packaging material in a sustained oxygen environment, said method comprising the steps of:

providing N substantially identical samples such that N is a positive integer of at least 2, wherein each of the N samples comprises the semiconductor packaging material, wherein T samples of the N samples are test samples, wherein C samples of the N samples are control samples, and wherein T and C are positive integers such that T+C=N;

exposing during a time period τ the T test samples to a pressurized gas having a total pressure $P_{TOT}(t)$, said pressurized gas comprising oxygen gas, wherein for times t during $0 \leq t \leq \tau$ the oxygen gas has a partial pressure P(t) of at least P_1 and a temperature T(t) satisfying $T_G-\Delta T_2 \leq T(t) \leq T_G-\Delta T_1$ such that $0<\Delta T_1 \leq \Delta T_2$ for glass transition temperature T_G of the molding compound, wherein during $0 \leq t \leq \tau$ the T test samples are exposed to moisture having a relative humidity H(t) such that $H_1 \leq H(t) \leq H_2$, wherein $H_1 \geq 0\%$ and $H_2 \leq 100\%$, wherein τ is at least about 12 hours, wherein P_1 is about 15 psi, and wherein $T_G-\Delta T_2$ is at least about 20 °C; and

exposing the C control samples during times t for a time period τ' to a pressurized inert gas having a pressure P'(t) and a temperature of T'(t) at a relative humidity H'(t), wherein a common time interval exists for times t during which both the pressurized gas comprising

oxygen and the pressurized inert gas are being exposed by the respective exposing steps, wherein during said common time interval: $P'(t) \geq P(t)$ or $P'(t)$ does not substantially differ from $P(t)$, $T'(t) \geq (T(t)$ or $T'(t)$ does not substantially differ from $T(t)$, and $H'(t) \geq H(t)$ or $H'(t)$ does not substantially differ from $H(t)$.

2. The method of claim 1, wherein τ' is about equal to τ.

3. The method of claim 1, wherein τ' does not substantially differ from τ.

4. The method of claim 1, wherein $\tau' < \tau$.

5. The method of claim 1, wherein $\tau' > \tau$.

6. The method of claim 1, wherein the N samples are essentially identical samples.

7. The method of claim 1, wherein the N samples each comprise a semiconductor package that includes the semiconductor packaging material.

8. The method of claim 3, wherein the N samples each comprise a portion of a semiconductor package, wherein the portion is less than the entire semiconductor package, and wherein the portion includes the semiconductor packaging material.

1 9. The method of claim 1, wherein the inert gas includes nitrogen.

1 10. The method of claim 1, wherein the molding compound includes phosphorus.

1 11. The method of claim 1, wherein the molding compound includes red phosphorus.

1 12. The method of claim 1, wherein the molding compound does not include phosphorus.

1 13. The method of claim 1, wherein N=1.

1 14. The method of claim 1, wherein N>1.

1 15. The method of claim 1, wherein $P'(t) \geq P_{TOT}(t)$ or $P'(t)$ does not substantially differ from $P_{TOT}(t)$.

1 16. The method of claim 1, wherein ΔT_2 is about equal to ΔT_1.

1 17. The method of claim 1, wherein H_2 is about equal to H_1.

1 18. The method of claim 1, wherein ΔT_2 is about equal to ΔT_1, and wherein H_2 is about equal to

H_1.

19. The method of claim 1, wherein during $0 \leq t \leq \tau'$: $T'(t)$ is about equal to $T(t)$.

20. A method of testing and analyzing a semiconductor packaging material containing a molding compound for stability of the semiconductor packaging material in a sustained oxygen environment, said method comprising the steps of:

providing N substantially identical samples such that N is a positive integer of at least 2, wherein each of the N samples comprises the semiconductor packaging material, wherein T samples of the N samples are test samples, wherein C samples of the N samples are control samples, and wherein T and C are positive integers such that T+C=N;

exposing during a time period τ the T test samples to a pressurized gas having a total pressure $P_{TOT}(t)$, said pressurized gas comprising oxygen gas, wherein for times t during $0 \leq t \leq \tau$ the oxygen gas has a partial pressure P(t) of at least P_1 and a temperature T(t) satisfying $T_G-\Delta T_2 \leq T(t) \leq T_G-\Delta T_1$ such that $0<\Delta T_1 \leq \Delta T_2$ for glass transition temperature T_G of the molding compound, wherein during $0 \leq t \leq \tau$ the T test samples are exposed to moisture having a relative humidity H(t) such that $H_1 \leq H(t) \leq H_2$, wherein $H_1 \geq 0\%$ and $H_2 \leq 100\%$, wherein τ is at least about 12 hours, wherein P_1 is about 15 psi, and wherein $T_G-\Delta T_2$ is at least about 20 °C;

exposing the C control samples during times t for a time period τ' to a pressurized inert gas having a pressure P'(t) and a temperature of T'(t) at a relative humidity H'(t), wherein a common time interval exists for times t during which both the pressurized gas comprising oxygen and the pressurized inert gas are being exposed by the respective exposing steps, wherein during said common time interval: $P'(t) \geq P(t)$ or P'(t) does not substantially differ from P(t), $T'(t) \geq$ (T(t) or T'(t) does not substantially differ from T(t), and $H'(t) \geq H(t)$ or H'(t) does not substantially differ from H(t);

wherein after said exposing the T test samples and the C control samples, the method further comprises:

measuring at least one characteristic common to the C control samples and the T test samples; and

determining whether there exists at least one significant difference between the at least one measured characteristic of the T test samples and the at least one characteristic of the C control samples.

21. The method of claim 20, wherein the N samples are essentially identical samples.

22. The method of claim 20, wherein the N samples each comprise a semiconductor package that includes the semiconductor packaging material.

23. The method of claim 22, wherein the N samples each comprise a portion of a semiconductor package, wherein the portion is less than the entire semiconductor package, and wherein the portion includes the semiconductor packaging material.

24. The method of claim 20, wherein measuring the at least one characteristic of the C control samples and the T test samples includes performing ion chromatography on the C control samples and the T test samples to determine ions and their concentrations present in the C control samples and the T test samples.

25. The method of claim 20, wherein measuring the at least one characteristic of the C control samples and the T test samples includes performing thermogravimetric analysis on the C control samples and the T test samples to determine a weight loss versus temperature for the C control samples and the T test samples, over a temperature range from a temperature T_1 to a temperature T_2 such that $T_1<T_2$.

26. The method of claim 20, wherein if the determining determines that said at least one significant difference exists then the method further comprises performing further testing, analysis, or testing and analysis of the semiconductor packaging material.

27. The method of claim 20, wherein if N>2 then said determining comprises performing a statistical analysis of the at least one characteristic of the C control samples and the T test samples.

28. A test environment, comprising a chamber containing S samples, a pressurized gas, and moisture, wherein the S samples each comprise a semiconductor packaging material that includes a molding compound, wherein S is at least 1 and if S>1 then the S samples are substantially identical, wherein the S samples are being exposed to the pressurized gas and the moisture, wherein the pressurized gas includes at least one of oxygen gas and an inert gas, wherein the pressurized gas has a temperature T satisfying $T_G-\Delta T_2 \leq T \leq T_G-\Delta T_1$ such that $0<\Delta T_1 \leq \Delta T_2$ for glass transition temperature T_G of the molding compound, wherein the moisture has a relative humidity H such that $H_1 \leq H \leq H_2$, wherein $H_1 \geq 0\%$ and $H_2 \leq 100\%$, wherein $T_G-\Delta T_2$ is at least about 20 °C, wherein if the pressurized gas includes the oxygen gas then the partial pressure of the oxygen gas is at least about 15 psi, and wherein if the pressurized gas does not include the oxygen gas then the pressure of the inert gas is at least about 15 psi.

29. The test environment of claim 28, wherein the S samples are essentially identical.

30. The test environment of claim 28, wherein the S samples each comprise a semiconductor package that includes the semiconductor packaging material.

31. The test environment of claim 28, wherein the S samples each comprise a portion of a semiconductor package, wherein the portion is less than the entire semiconductor package, and wherein the portion includes the semiconductor packaging material.

32. The test environment of claim 28, wherein the pressurized gas includes oxygen.

33. The test environment of claim 28, wherein the pressurized gas includes the inert gas.

34. The test environment of claim 28, wherein the pressurized gas includes the inert gas, and wherein the inert gas includes nitrogen.

35. The test environment of claim 28, wherein the molding compound includes phosphorus.

36. The test environment of claim 28, wherein the molding compound includes red phosphorus.

37. The test environment of claim 28, wherein the molding compound does not include phosphorus.

38. The test environment of claim 28, wherein S=1.

39. The test environment of claim 28, wherein S>1.